Jihai Zhao

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EDUCATION

Northwestern University
M.S. in Robotics Sept. 2023 – Dec. 2024

The Ohio State University
B.S. with Honors in Mechanical Engineering and Minor in Computer Science Sep. 2019 - May. 2023

SKILLS

Robotics: Robot Operating System(ROS/ROS 2), OpenCV, Stereo Vision, Simultaneous Localization and Mapping(SLAM), MoveIt, Rviz, Gazebo, Intel RealSense, Reinforcement learning, Kalman Filter, RRT
Programming: Python, C++, C, MATLAB/Simulink, PyTorch, TensorFlow, R
Software: Linux, CMake, Git, Unit Tests, Docker
Hardware: SolidWorks/OnShape, Additive Manufacturing, Rapid Prototyping

WORK EXPERIENCE

Realman-Robotics - Robotics Software Engineer Intern Jun. 2024 – Sept. 2024

- Implemented an S-curve velocity planning algorithm in C++ for smooth acceleration/deceleration in gripper operations.
- Mounted two industrial cameras as Stereo Vision system and calibrated them to find absolute accuracy of the robot arm.
- Designed and programmed a self-calibration procedure for an industrial robot to follow a spherical trajectory, using Stereo Vision to measure distances from endpoints to the sphere's center, and formulized the error function.
- Used least squares method to optimize kinematic parameters, improving absolute accuracy by 40% in target workspace

PROJECT

LVMs and VLMs based Robot Manipulation (In Progress) Sept. - Dec. 2024

- Used Segment Angything (SAM) to extract all masks in the scene to ensure covers all relevant objects and cluster the masked features based on k-means. Then extract the patch-wise features from DINOv2 (a vision model).
- Used prompt to fed the image and the task instruction to vision-language model (GPT-4o) to generate the required stages and actions to guide the robot finish manipulation tasks.
- Utilized 3D point cloud data to compute grasp poses, ensuring robust interaction with objects in diverse environments.

3D-Bin-Packing With a 7-DOF Robot Arm Jan. - Mar. 2024

- Implemented the First-Fit algorithm (In Python) to determine where to place 3D objects in a bin with a known size.
- Used color masking in OpenCV to isolate the 3D objects' color pixels in the camera's view and programmed in Python to identify the location and dimensions of 3D objects.
- Used MoveIt to control the robot to grasp objects and place them in the packing area, according to the location calculated from the First-Fit algorithm.

Simultaneous Localization and Mapping (SLAM) from Scratch Jan. – Mar. 2024

- Programmed Extended-Kalman filter SLAM from scratch in C++ using ROS2 for a Turtlebot3 differential drive robot.
- Developed a C++ package for differential drive kinematics, collision detection, 2D transformations, and odometry.
- Implemented a landmark detection algorithm through supervised learning.
- Used C++ to implement a custom simulation environment for the robot, including lidar, obstacles, and collisions.

Making Coffee With a 7-DOF Robot Arm Sept. – Dec. 2023

- Worked in a group of five to develop ROS2 packages to control the Franka robot arm to brew a cup of coffee.
- Used Computer Vision (OpenCV and AprilTags) to find the location of each object and wrote a custom wrapper package for MoveIt in Python to control the robot.
- My focus was on grasping, and planning trajectory for objects while holding them level (particularly the coffee filter).

KUKA YouBot Manipulation Sept. – Dec. 2023

- Planned a trajectory for the end-effector of a mobile base with four mecanum wheels and a 5R robot arm by using feed-forward control and a PI controller.
- Performed feedback control to drive the YouBot to pick up a block at a specified location, carry it to a desired location, and put it down. It was simulated in CoppeliaSim.

Vision Transformer for Surface Defect Inspection Jun. - Oct. 2022

- Applied Vision Transformer (VT) model to surface defect detection. The VT model combines image linear projection, position embedding as the input, and multilayer perceptron (MLP) as the classifier.
- Achieved 93.3% accuracy and 0.9302 F1 score on the dataset of aluminum surface flaws, demonstrating it performs better than other CNN baselines (including VGG19, DenseNet, and ResNet).